tible influence in preventing the occurrence of tornadoes, or in assuaging their violence.

In this connection, it should not be forgotten that the conditions which give rise to the development of tornadoes exist in the cloud-regions of the atmosphere, and not at the surface of the earth. Forests would prevent the occurrence of whirlwinds, because these phenomena depend upon the unstable state of the atmosphere at the earth's surface, where the conditions are favorable for the sun's heat to accumulate in the surface strata of the soil, and thus superheat the air resting upon it. A heavy growth of timber or rank vegetation will prevent this action of the sun's rays.

Whenever a tornado-cloud encounters a forest, the destruction is complete and terrible. The forces of the tornado-cloud are quickly brought into operation, and maintained continuously while the phenomenon exists. They are not affected by having to meet in rapid succession totally different objects, different in size, strength, shape, materials, composition, structure, relative position, etc.

The width of the path of destruction, as determined from the records of 88 years, varies from 10 to 10,560 feet, the average being 1,369 feet. The length of the tornado-track varies from 300 yards to about 200 miles, the average being 24.79 miles. The velocity of progression of the tornado-cloud varies from 7 to 100 miles per hour, the average being 44.11 miles. These extremes may often occur in different portions of the track of a single tornado. The shortest time occupied by the tornado-cloud in passing a given point varies from "an instant" to about 20 minutes, the average being about 74 seconds.

The month of greatest frequency, that is, the month embracing the largest number of days in which tornadoes occurred, is May. The prevailing direction of the progressive movement of the tornado-cloud is north-east. The vortex wind velocities of the tornado-cloud vary from 100 to 500 miles per hour, as deduced from actual measurements. Velocities of from 800 to 1,000 miles per hour are extremes that have been reported, but may not be altogether reliable. Theoretical velocities of 2,000 miles and over per hour, based upon certain assumed atmospheric conditions, have been deduced. Such velocities are mathematically possible, but not meteorologically probable.

The concomitants of the tornado are, an oppressive condition of the air; the gradual setting-in and prolonged opposition of northerly currents and southerly currents over a considerable area; a high temperature, and the presence of considerable moisture; a gradual but continual fall of the thermometer with the prevalence of northerly currents, and a rise with the predominance of southerly; a rapid decrease of temperature with increase of altitude; a decided gradient of temperature across the line of progressive movement; huge masses of dark and portentous clouds in the north-west and south-west, possessing a remarkable intensity of color, usually a deep green; a remarkable rolling and tumbling of the clouds, scuds darting from all points of the compass towards a common centre; hail and rain accompanying the tornado, the former either in unusual size, form, or quantity, and the latter either remarkable in quantity or size of drops; the presence of ozone in the wake of the tornado; a remarkable roaring noise, like the passage of many railroad-trains through a tunnel.

The cloud generated by the vortex assumes the form of a funnel, with the smallest end towards the earth. This explains the remarkable contraction of the storm's path. Upon reaching the earth's surface, the vortex has four motions: viz., first, the whirling or gyratory motion, always from right to left; second, the progressive motion, generally from some point in the south-west quadrant to some point in the north-east quadrant; third, the curvilinear motion; fourth, oscillatory motion.

The characteristic effects of a tornado are, objects are drawn towards the vortex from every point of the compass; objects passing into the vortex are thrown upwards and outwards by the vortical action of the engaged air; structures are literally torn to pieces by the vortical action of the air, evidence of which is afforded by the fineness of the *débris*, and also its disposition in the storm's path; the *débris* is thrown inward from each side of the storm's path; light objects are carried to great heights and also to great distances; objects are carried inward and upward by the centripetal, and outward by the centrifugal, forces of the vortex; weight and size are conditions which generally present immaterial values to the power of the tornado; persons are stripped of clothing; fowls and birds are denuded of feathers and killed; trees are whipped to bare poles; heavy objects are carried for miles in the air; long and heavy timbers are driven to considerable depths in the solid earth; the vortex is completely filled with flying *débris*; timbers are driven through the sides of buildings; sand and gravel are driven into wood; the strongest trees are uprooted, or twisted off near the roots; men and animals are terribly mangled by contact with flying *débris* and by being rolled over the ground for a considerable distance; in the path of the storm all vegetation is destroyed; railroad-trains are thrown from the track; iron bridges are completely dismantled and carried from their foundations; heavy bowlders, weighing tons, are rolled along the earth; the largest railroad-engines are lifted from the tracks on which they rest; all objects, whether metal or non-metallic, magnetic or non-magnetic, simple or compound, animate or inanimate, are acted upon in a similar manner.

THE SITUATION IN SAMOA.

THE continuous disturbances on the Samoa Islands, and their bearing upon questions of great political importance, give to these islands a special interest. The group consists of thirteen islands, only three of which are of commercial interest, — Savaii, Upolu, and Tutuila. Savaii is the largest island of the three, measuring some 40 miles from east to west by 20 miles from north to south, and having an area of 700 square miles. It has no harbor of any importance, and in this respect it contrasts strongly with Upolu and Tutuila. The little bay of Mataatu, in the extreme north of the island, is the only place where large vessels can anchor; but even it is not safe from November to February. The interior of the island is occupied by two mountain-ranges of volcanic origin. It has no rivers or streams, the water filtering away through the porous soil. Where the mountains approach the coast, the latter is very steep and inaccessible, while in other places a well-wooded strip of alluvial land is found, on which numerous villages are situated. The sterility of the interior of this island has always been a barrier to all settlement or cultivation, and even to the visits of travellers and explorers.

Upolu, which covers an area of 550 square miles, is also mountainous, but it is well wooded and fertile, and possesses several considerable streams, although they are, of course, not navigable. On the northern coast of this island lies Apia, the chief town of the whole Samoan group. It is prettily situated, having a background of mountains thickly wooded, and a foreground of harbor and coral reefs. The harbor consists of two portions, the most westerly being the best for vessels that intend to remain for any length of time, especially during the rainy season. For sailing-craft, a steady breeze is absolutely necessary on entering or leaving the harbor, as a strong current sets along its entrance.

Passing down the coast east of Apia, a succession of beautiful bays are met with. At the distance of from half a mile to two miles from the shore a coral reef protects this portion of the island for nearly twenty miles. At high tide canoes and boats can pass between this and the mainland, and thus a great deal of the insular traffic is carried on.

As seen from the sea, there are not many islands in the Pacific that present a more beautiful or picturesque appearance than Upolu. It shows a bold and majestic front, the central range being not less than 3,000 feet high, and wooded almost to its summit. It is throughout a very fertile island, and fully equal to the best portions of the Fiji group.

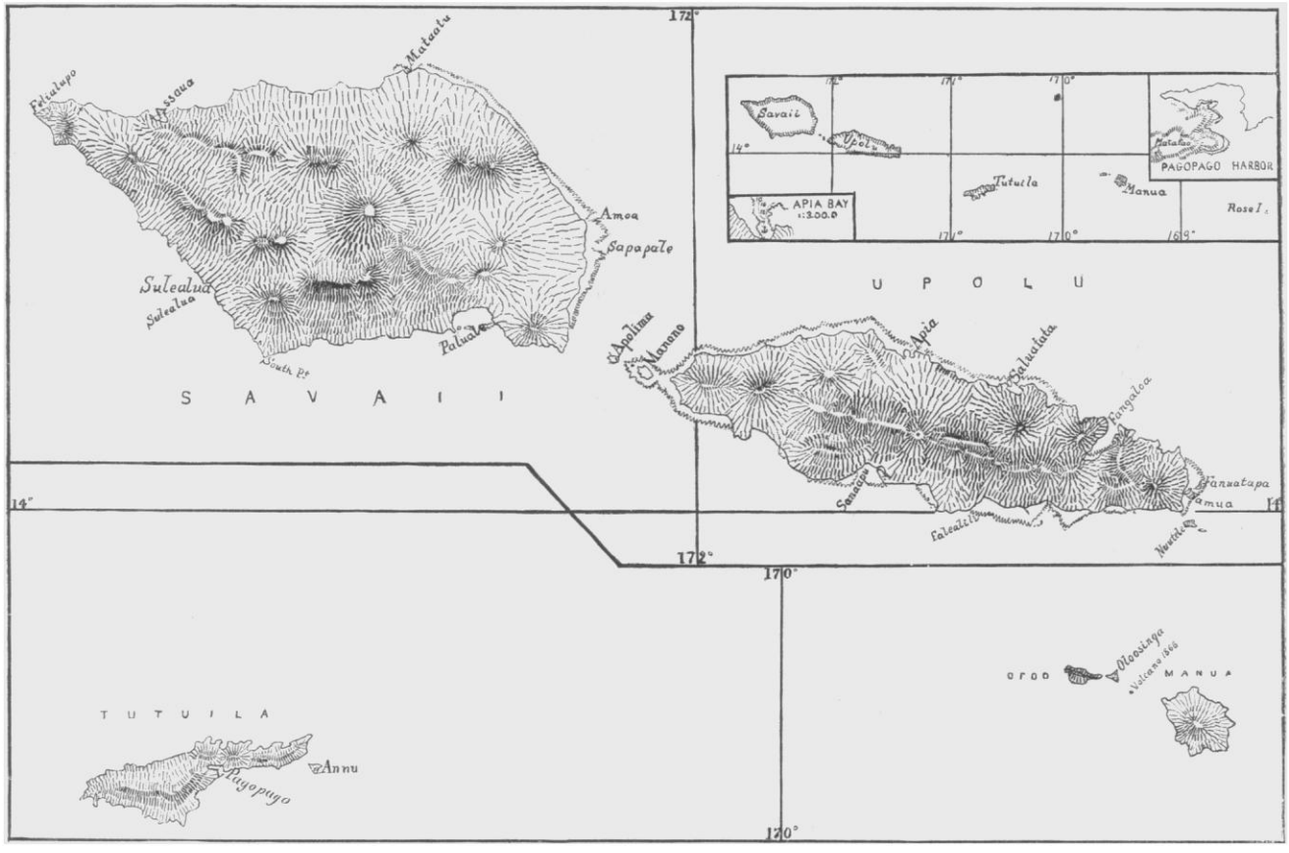
Tutuila is about 17 miles long and 5 broad. On its southern side is the deep bay of Pagopago, which almost cuts the island in two. This harbor, which is one of the best in the whole South Pacific, is surrounded by hills from 2,000 to 3,000 feet high. Surrounding the harbor at their base is a small strip of level land. The harbor is half a mile wide at its entrance, and runs north and south for a distance of a mile, when it turns in a westerly direction, and opens out into a fine sheet of water. It is somewhat difficult for sailing-vessels to leave, in consequence of the trade-winds blowing directly into it; but for steamboats it is unsurpassed by

any harbor among all islands of the South Pacific. Here vessels of any size can lie at anchor, secure from every wind, all the year round. It is well adapted as a coaling station or for refitting and repairing ships, and affords, moreover, plentiful supplies of timber, food, and water.

Upolu, and to some extent Tutuila, have attracted a considerable number of American and European capitalists, the latter mostly Germans; and a large portion of the land has passed into the hands of foreign residents, who number about three hundred. The bulk of the foreign trade belongs to the successors of the famous Hamburg firm of J. C. Godefroy & Son. Cotton, cocoanuts, and bread-fruit are cultivated for export; and maize, sugar, coffee, etc., for local consumption. Copra (dried cocoanuts) is the most important article of trade. In 1881 the planters had about 1,800 laborers from the Line Islands, New Britain, New Hebrides, etc., the Samoans being too independent to hire themselves out.

Among the natives of these islands dissensions have always been raging, and the European traders did not fail to take advantage of their internal wars. In 1860 the firm of Godefroy, which at that time encountered no considerable competition in the Pacific, stood on the side of Malietoa, a chief belonging to one of the most distinguished families of Samoa. Although Malietoa was never in reality ruler over the whole group of islands, he assuredly had the expectation of the first place in the country, and the royal title was formerly willingly given him.

Throughout the next twenty years, which passed with continuous dissensions among the natives, the Europeans who had gradually settled in Samoa, Germans, Englishmen, and Americans, found abundant opportunity to meddle in the quarrels of the inhabitants, which they did accordingly in the fullest measure. They sought, by taking sides with or against Malietoa, to strengthen respect for their nations, and thereby increase their commerce. Since Malietoa was influenced principally by Americans, the German Commercial and Plantation Society, who had originally supported him, took the opposing side, and in 1887 helped Tamasese to dethrone his old adversary. Before the recent uprising, a German, Tamasese's prime minister, was in reality possessor of all power, under the protection of German guns. Tamasese is, of course, as much of a puppet in the hands of the Europeans as Malietoa has always been. The conflict between the native parties has reference not so much to whether the one or the other person be king, as to the question of whether Germany or England-America shall retain the upper hand.



MAP OF THE SAMOA ISLANDS.

HEALTH MATTERS.

Poisonous Milk.

PROFESSOR L. P. KINNICUTT of the Worcester (Mass.) Polytechnic Institute reports to the *Boston Medical and Surgical Journal* five cases of poisoning by milk in which, upon chemical analysis, he found tyrotoxicon.

The milk was in a pint beer-bottle with patent rubber stopper, and appeared and tasted perfectly fresh and good. After carrying it to the laboratory, it was allowed to remain in the tightly stoppered bottle for one week before it was examined. The milk had by that time decomposed, separating into two layers. It was filtered through thick Swedish filter-paper, the filtrate neutralized with a dilute solution of sodium hydrate, placed in a separating-funnel, and shaken thoroughly with ether. A thick emulsion formed, and it was only after four days, and by the use of various mechanical means, that a separation could be effected. The ether solution was allowed to evaporate at the ordinary temperature, and the residue carefully tested. Re-actions were obtained which agreed perfectly with those given by Vaughan (*Journal of Analytical Chemistry*, vol. i. pp. 25 and 281) for tyrotoxicon. There is therefore no doubt that the poisonous action of the milk was caused by the same poison that Vaughan found in the various cases cited by him.

A visit to the dairy from which the milk was obtained was made, and it was found that the herd consisted of fifteen Jersey cows, all in the best condition, well fed and cared for. The dairy supplies about forty families with milk, and the milk of all the cows is mixed together before subdividing it into the various portions; and as only one family out of the forty supplied with the milk, as far as can be found out, suffered from any poisonous effect, it proves that